Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

In the Matter of	)	
Facilitating Opportunities for Flexible, Efficient and Reliable Spectrum Use Employing Cognitive Radio Technologies	)	ET Docket No 03-108

COMMENTS OF
THE INFORMATION TECHNOLOGY INDUSTRY COUNCIL

The Information Technology Industry Council (ITI) hereby respectfully submits comments in response to the above-captioned Notice of Proposed Rule Making ("NPRM" or "Notice").[1] ITI applauds the Commission's continued efforts to address spectrum issues including the use of technologies and concepts that promote more efficient spectrum use.[2] We have been strongly encouraged by the Commission's foresight in exploring innovative technologies such as software defined radio (SDR), while at the same time seeking to apply appropriate regulation to govern the use of

[1] *Facilitating Opportunities for Flexible, Efficient and Radio Spectrum Use Employing Cognitive Radio Technologies*, ET Docket No. 03-108, *Notice of Proposed Rulemaking and Order*, released December 30, 2003.

[2] Recent Commission actions include: *In the matter of Establishment of an Interference Temperature Metric to Quantify and Manage Interference and to Expand Available Unlicensed Operation in Certain Fixed, Mobile and Satellite Frequency Bands*, ET Docket No. 03-237, *Notice of Inquiry and Notice of Proposed Rulemaking*, released November 28, 2003 (hereinafter "Interference Temperature Notice"); *In the matter of Revision of Parts 2 and 15 of the Commission's Rules To Permit Unlicensed National Information Infrastructure (U-NII) devices in the 5 GHz band*, ET Docket No. 03-122, *Report and Order*, released November 18, 2003, recon. pending.

"smart antennas" for Part 15 radio local area network (RLAN) devices. With this Notice, the Commission takes the next step by examining and seeking comment on cognitive radio as a means to improved spectrum use

ITI recognizes that as it revises or adopts new methods to promote spectrum efficiency, the Commission must protect licensed services while also avoiding unnecessary restrictions that could hinder deployment of emerging technologies. As this NPRM reflects, cognitive radio and SDR offer promising new ways to facilitate band sharing, but they also present the challenge of protecting existing services operating in these bands. Among other things, the Notice proposes an immediate increase in the power of unlicensed devices operating in the 900 MHz, 2.4 GHz, 5.8 GHz, and 24 GHz bands.[3] ITI is pleased that the Commission is looking for ways to advance the utility of unlicensed devices, and we believe increased power will make unlicensed systems more useful to consumers and businesses. However, ITI wishes to make clear that future power changes should not create harmful interference to incumbent users in this band or increase interference among unlicensed devices. For this reason, ITI urges the Commission to proceed carefully, perhaps selecting one band to implement cognitive radio technology before introducing it more generally. Not only is it important to gain operational experience with cognitive devices, but the process of devising equipment authorization tests and measurements is a fairly significant task. Indeed, the relatively straightforward task of implementing test rules for equipment with dynamic frequency selection in the 5 GHz band is a 19-month process.

[3] Notice at Appendix A, proposed rule section 15.206.

BACKGROUND

The Information Technology Industry Council represents the top U.S. providers of information technology products and services. ITI is the voice of the high tech community, advocating policies that advance industry leadership in technology and innovation, opening access to new and emerging markets, supporting e-commerce expansion, protecting consumer choice, and embracing the global competitiveness of its member companies. As such, ITI has a keen interest in both fostering new technology that will allow continued growth of unlicensed operations, as well as ensuring that unlicensed devices do not cause harmful interference to those that are licensed. With these dual interests, ITI is encouraged by and generally supports the Commission's proposals on cognitive radio as put forth in the Notice.

In our response, ITI concurs with the Commission's opinion that cognitive radio could help to accelerate broadband deployment, especially in rural areas. At the same time, ITI suggests a cautious approach to ensure interference issues are minimized. ITI also offers a response to modifications of Part 2 rules. In particular, we propose guidelines for determining the need for cognitive radios to be filed as SDRs. In addition, we offer suggestions to ensure that the proposed regulations for SDR and cognitive radio allow for secure operation that avoids end user manipulation and ensures proper configuration, while not being overly restrictive with regard to related component technologies. ITI also addresses the issue of passive scanning, or "world mode," for Part 15 Wi-Fi devices.

DISCUSSION

I. Application: Rural Markets and Unlicensed Devices

ITI supports the Commission's view that the use of cognitive radios would help to facilitate rural broadband deployment.[4] The Commission has addressed rural broadband access in several recent rulemakings and has held various seminars to explore solutions to accelerating deployment.[5] ITI supports these efforts and is especially encouraged by the Commission's recognition that unlicensed Part 15 systems can play a significant role in meeting this goal.[6] However, the Commission must be cautious in its approach to expanding power in already densely used 900 MHz and 2.4 GHz bands, as this might result in an increase in interference. Increasing power in the 900 MHz, 2.4 GHz, and 5.8 GHz bands should only be permitted if the Commission determines that the proposed sensing method or other approach adequately addresses the potential for creation of a tragedy of the commons. We further encourage the Commission to consider the adoption of "smart antennas" for these Part 15 devices as discussed in the Commission's

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[4] Notice at par. 36-47. As the FCC defines rural, it should include in its definition areas where the interference potential is low and not solely define rural by geographic area.

[5] See *In the matter of Facilitating the Provision of Spectrum-Based Service to Rural Areas and Promoting Opportunities for Rural Telephone Companies to Provide Spectrum-Based Services, Notice of Proposed Rulemaking*, WT 02-381, 2000 *Biennial Regulatory Review Spectrum Aggregation Limits for Commercial Mobile Radio Services*, WT Docket No. 01-14, *Increasing Flexibility to Promote Access To and the Efficient and Intensive Use of Spectrum and the Widespread Deployment of Wireless Services, and To Facilitate Capital Formation*, WT Docket No. 03-202, *Notice of Proposed Rulemaking*, released October 6, 2003.

[6] See ITI comments, dated September 2, 2003, filed in *In the matter of Modification of Parts 2 and 15 of the Commission's Rules for unlicensed devices and equipment approval*, ET Docket No. 03-201, *Notice of Proposed Rulemaking*, released September 17, 2003.

Unlicensed Devices proceeding.[7] This will further advance the rollout of higher power systems and reduce the potential for interference.[8]

II. Modifications to Part 2 of the Commission Rules.

A. SDR Equipment Authorizations

The Notice asks whether the Commission should require that certain devices be declared as an SDR for equipment authorization purposes.[9] The Notice states that the Commission's goal in mandating SDR authorization is to minimize the risk of unauthorized operation of SDRs in cases where the transmission control software can be easily modified and to avoid SDR authorization where it cannot.

A mandatory filing requirement could act as a disincentive to investment in SDR technology, retard its deployment, and burden the industry by restricting the use of an efficient manufacturing technique. A large percentage of radios manufactured today would already meet the Commission's definition of SDR. Mandating an SDR filing would therefore create an excessive regulatory requirement for industry to meet. Moreover, ITI believes the requirement to protect radios from abuse is already a responsibility of manufacturers.

ITI agrees with the Commission's view that not all radios that meet the broad definition of an SDR are easily modifiable after manufacture. For those manufacturers that allow the upgrade of their radios using the new class III permissive change, ITI

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[7] *In the matter of Modification of Parts 2 and 15 of the Commission's Rules for unlicensed devices and equipment approval*, ET Docket No. 03-201, *Notice of Proposed Rulemaking*, released September 17, 2003.

[8] Though operating at a higher power, rural-based systems would not be as densely deployed, thereby reducing possible interference to other systems. In addition, compliance with Part 15 band-edge and out-of-band emission requirements would effectively limit the power of associated devices.

[9] Notice at par. 88.

proposes that current rules are adequate. However, for those devices where SDR techniques have long been used in the manufacturing process, and are not intended to be modified in the field, SDR filing should not be required.

At the core of the issue is the question of whether the correct incentive exists for manufacturers to include the necessary safeguards against unauthorized operation. We believe such incentives do exist to propel manufacturers to adopt secure methods for the proper configuration by installers for enterprise systems. Security solutions, such as those described below, will allow installers to properly configure a product for use in various countries and eliminate the need for manufacturers to create multiple models for products that are essentially identical.

With regard to the Commission's inquiry about partitioned modules, ITI recommends a similar approach. Where the intent is to change a product after manufacturing, existing SDR rules should be sufficient. Without this intent, ITI proposes that these rules do not need to be applied.

In addressing the issue of digital-to-analog converters (DACs), ITI understands that the Commission may have concerns regarding a DAC card with unauthorized software being configured by a remote user to operate on a frequency band not approved by the Commission. However, ITI does not believe that DACs, alone, represent a significant risk. By restricting them, the FCC would set a dangerous precedent in applying intentional radiator rules to unintentional radiator devices. This would create an undue regulatory burden on manufacturers and result in increased costs for consumers. Therefore, ITI strongly opposes the Commission's proposal in paragraph 92 of the Notice to restrict the mass marketing of high-speed DACs.

B. ***Ensuring Flexible Security Solutions***

The Notice also seeks comment on whether rule changes are needed to improve security and authentication requirements for cognitive radios.[10] As cognitive radios are developed and deployed in greater numbers, control over a radio's operating parameters will likely shift to software (e.g., firmware driving a hardware component) because managing complex behavior in software is much more cost-effective than in hardware. Like the firmware of existing cellular and unlicensed devices, this software will be increasingly easier to update in order to adapt to new government rules and new market requirements, and hardware, for its part, must become much more flexible to enable greater software control. As a result of this co-evolution, incorrect or malicious software updates could turn a complying device into a non-complying device[11]

Both hardware and software manufacturers have strong incentives to prevent such unauthorized modifications, precisely because they can adversely affect not just one device but a whole class of devices as well as other users of the spectrum. Consequently, the field of trusted computing has already begun to develop flexible, effective mechanisms for software updates that allow the implementation of new operational rules that greatly reduce the danger from harmful software updates.

One simple technique would be for a manufacturer's hardware to ensure upon each power-up that its firmware has been digitally certified by the manufacturer using standard techniques from public-key cryptography. Under such an approach, the hardware manufacturer could issue and certify updated firmware when firmware

[10] Notice at par. 30 and 94.

[11] Notice at par. 30.

problems are found. This approach works well when the hardware and software come from the same supplier. However, in situations where systems contain hardware and software components from a number of suppliers, the only software that any given hardware manufacturer can directly control is the software that runs on its own hardware.[12] In the future we expect that devices incorporating flexible transmitters will be built from hardware and software components from a number of suppliers and these components should be able to interoperate in flexible ways while maintaining the compliance of the device as a whole.

A more robust solution may be offered by technology known as "software attribution," which allows an external software component digitally to sign its results so that any signal to be transmitted can first be traced back (inside the device) to the software component that generated it. Using attribution, a flexible hardware transmitter component could transmit signals generated by a variety of external software components, but first verify that those components were certified to comply with FCC rules. These external software components could come from anywhere—they could even be downloaded only when needed—but an incorrect or malicious software component could not cause the signals it generated to be transmitted. Allowing software components to be provided by a variety of suppliers will create a marketplace in these components and will accelerate the evolution of new software and new hardware.

[12] For example, imagine a complex future device containing a flexible hardware transmitter component, and also containing one or more powerful general-purpose CPUs capable of executing arbitrary software. Practical engineering considerations might in many cases suggest that the complex signal to be transmitted would best be generated by one or more software components running on the general-purpose CPUs. Unfortunately, however, the transmitter component's manufacturer cannot then guarantee that the signal to be transmitted complies with the applicable FCC rules, since the software that generates it is external from the transmitter component.

In order not to hinder innovation and the development of secure cognitive radios, the FCC's rules for cognitive radio should not limit the use of software attribution or other innovative techniques from the new field of trusted computing in the construction of complex devices containing components from multiple suppliers. In particular, the rules should not require the hardware to restrict its flexible interoperation with external software components, except to the extent required to ensure compliance with FCC rules for the device as a whole or for the system as a whole.

III. Part 15 Issues.

A. *Allow the manufacture of equipment that can be sold worldwide*.

The Notice proposes to allow certification of Part 15 devices that operate on non-U.S. frequencies, provided that such devices are equipped with dynamic frequency selection to enable the device to operate only on the U.S.-specific frequencies.[13] ITI strongly endorses a rule change that will allow manufacturers of devices to produce one device that can be sold worldwide but that is equipped to operate only on the frequencies authorized by the country in which the device operates.

ITI submits that allowing the end user to configure the systems would create unnecessary risk that the device could be deployed on an unauthorized frequency. However, we believe that giving this ability to a system installer in an enterprise or service provider environment should be permissible if the end user has no overall control of the system. ITI does not believe that such devices need to be equipped with dynamic frequency selection (DFS). DFS selects an open frequency according to the channel set

[13] Notice at par. 97.

defined by the access point. DFS alone does not have the capacity to define what country the device is operating in, and what frequencies are permitted.

Accordingly, ITI strongly recommends that accommodations be made to allow for automatic frequency selection (AFS) for unlicensed devices. As a transition measure, passive scanning should be allowed to serve the same purpose for these client devices. If all network access points are set to the approved frequencies in the U.S., a client device will connect to the access points that are controlled to operate in the frequency bands allowed in the U.S. Whether using TGd[14] or passive scanning as a transitional mechanism, clients should be able to operate within regulations.

Furthermore, ITI suggests that while it may be possible to certify a 2.4 GHz Wi-Fi device to operate on U.S. channels 12 and 13 with reduced power and additional filters, it may not be in the best interest of the consumer or industry to allow these certifications. Inclusion of these channels will create implementation and transition obstacles to certain proposals under automatic frequency selection for unlicensed devices. In the case where the access point or some other device in the network is capable of supplying the frequency selection information to the network client as specified in IEEE 802.11 TGd, it will be imperative that the access point is not one of these uniquely certified devices to operate in channels 12 and 13. Otherwise, it may draw a network client card that does not have these unique abilities out of compliance. One of the possible solutions to address the concern on improperly configured access points is for the Commission to limit the channel set to the standard 1-11 channels, even during the transition period, so that a client device that can passively scan for available access points without the TGd

[14] TGd is the IEEE 802.11 Task Group "d"

mechanism will be in full compliance by connecting to any access point operating within existing regulations.

B. Testing Procedures Need Modification

We support the Commission's view to allow Part 15 devices to operate at higher power levels, such as in rural areas and in bands that are substantially underutilized, as long as additional mitigation and operational requirements are met. In reviewing the proposed testing requirements, we offer the following modifications.

First, in testing cognitive radio devices the procedures will need to take into account the effects of allowing the device to operate at higher power. With an increase in transmitter power, out-of-band emissions will increase. In the 2.4 GHz band, the issue of concern would be the upper channel and how the increase in power would affect compliance in the adjacent restricted band as well as the harmonics that fall into the restricted bands. Both the cognitive transmitters and the testing procedures would need to take these different out-of-band emissions into account if higher power is permitted.

Second, little technical work or real-world testing on the impact of higher-power operation has been conducted in the 900 MHz and 2.4 GHz bands and it is therefore difficult to estimate the impact of introducing higher power transmitters. Because of the intensive use of these bands, any increase in power of unlicensed devices operating in the 900 MHz and 2.4 GHz bands would likely result in significantly more interference. For this reason, ITI would urge the Commission not to permit higher power operation in these bands.

In addressing receiver requirements for the Part 15 devices, the 802.11 standard has specific requirements. Therefore, setting arbitrary receiver requirements could

negatively impact these devices, effectively reversing the Commission's previous decision to remove receiver requirements for Part 15.247 devices.[15] Currently the subject of an NOI, receiver requirements remain unresolved. Therefore, it is premature to begin addressing receiver specifications for Part 15 devices at this time.[16]

Several of the tests proposed, such as "time for listen before talk" or those that measure the detection of various standard signals, would require the tester to adopt the worst case mode for each band of operation to ensure detection of all devices to avoid interference. This is likely to be similar to work currently being conducted on DFS for 5 GHz.

CONCLUSION

ITI supports the majority of the Commission's NPRM proposals. We endorse the Commission's view that unlicensed devices may be able to operate at higher power with the proper cognitive rules and equipment authorization test procedures, especially in bands that are substantially underutilized. However, ITI wishes to make clear that future power changes should not create harmful interference to incumbent users in this band or increase interference among unlicensed devices. For this reason, ITI urges the Commission to proceed carefully, perhaps selecting one band to conduct extensive real-world testing of cognitive radio technology before introducing it more generally. In addition, ITI offers minor adjustments to Part 2 rules and the Part 15 rules. Cognitive radio should foster the continued growth of unlicensed services and should, properly

[15] This issue was dealt with in respect to RLAN in the Second Report and Order 99-231, which supported removing receiver (processing gain) requirements for Part 15 RLAN devices.

[16] As stated in Part 15 rules, these devices must accept all interference including that which affects their operation. There is no safe harbor for Part 15 devices. Therefore, we question the proposal to include mandatory receiver requirements other than those found in the 802.11x standards.

implemented, present little discernible risk to licensed services, thereby promoting the use of cognitive radio in beneficial applications including rural broadband deployment.

Respectfully Submitted,

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